

FL Department of Transportation Transportation Statistics Office

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Evaluation of Quartz WIM Data Using Enforcement Scale Data

- Goal

Conduct an objective evaluation of quartz piezoelectric weight sensors. This will be accomplished by comparing data collected at the WIM site with data from the same vehicles collected at an enforcement scale.

Background

- From 1974 – 1986 FDOT collected WIM data using the Radian WIM system.
- The Department installed 13 Bending plate sites from 1987 to 1992 statewide.
 - These sites provided accurate WIM data.
 - They have performed well over time (some are still in service).
 - However, they are expensive to install.
 - They are more suited to rigid pavement. The excavation required for installation of bending plates is more likely to affect the integrity of the pavement.

Background

- The FDOT has installed over 20 piezoelectric WIM sites statewide.
 - Less expensive to install and repair
 - Create less of an impact on the roadway making them more acceptable for flexible pavement. Florida has a lot of flex. pavement.
 - But, their output is affected by temp. variance
 - Have trouble meeting acceptable accuracy requirements

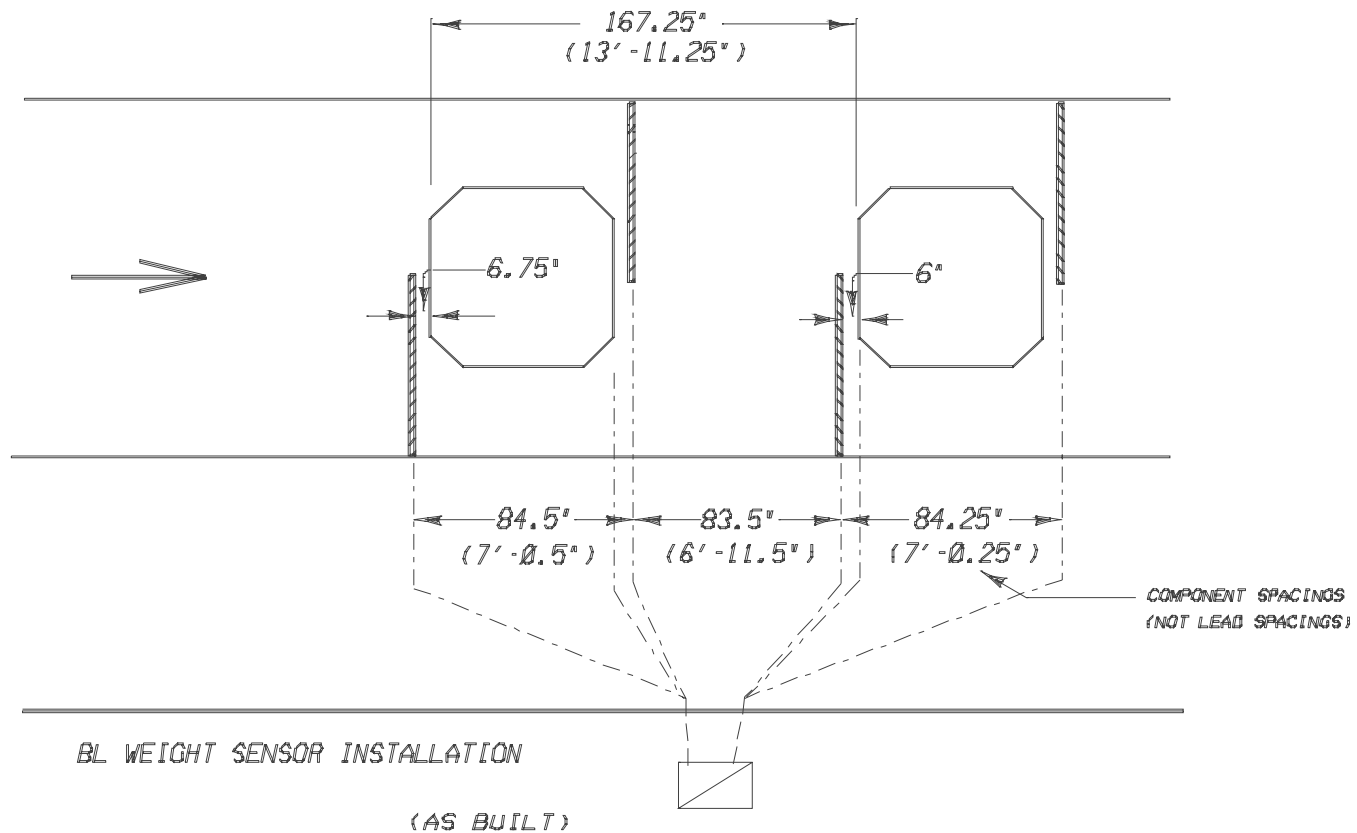
Background

- The Department recognizes a need to explore alternative sensors for WIM applications.
- We issued a task work order for Digital Traffic Systems to install a test site to examine different weight sensors and electronics units.

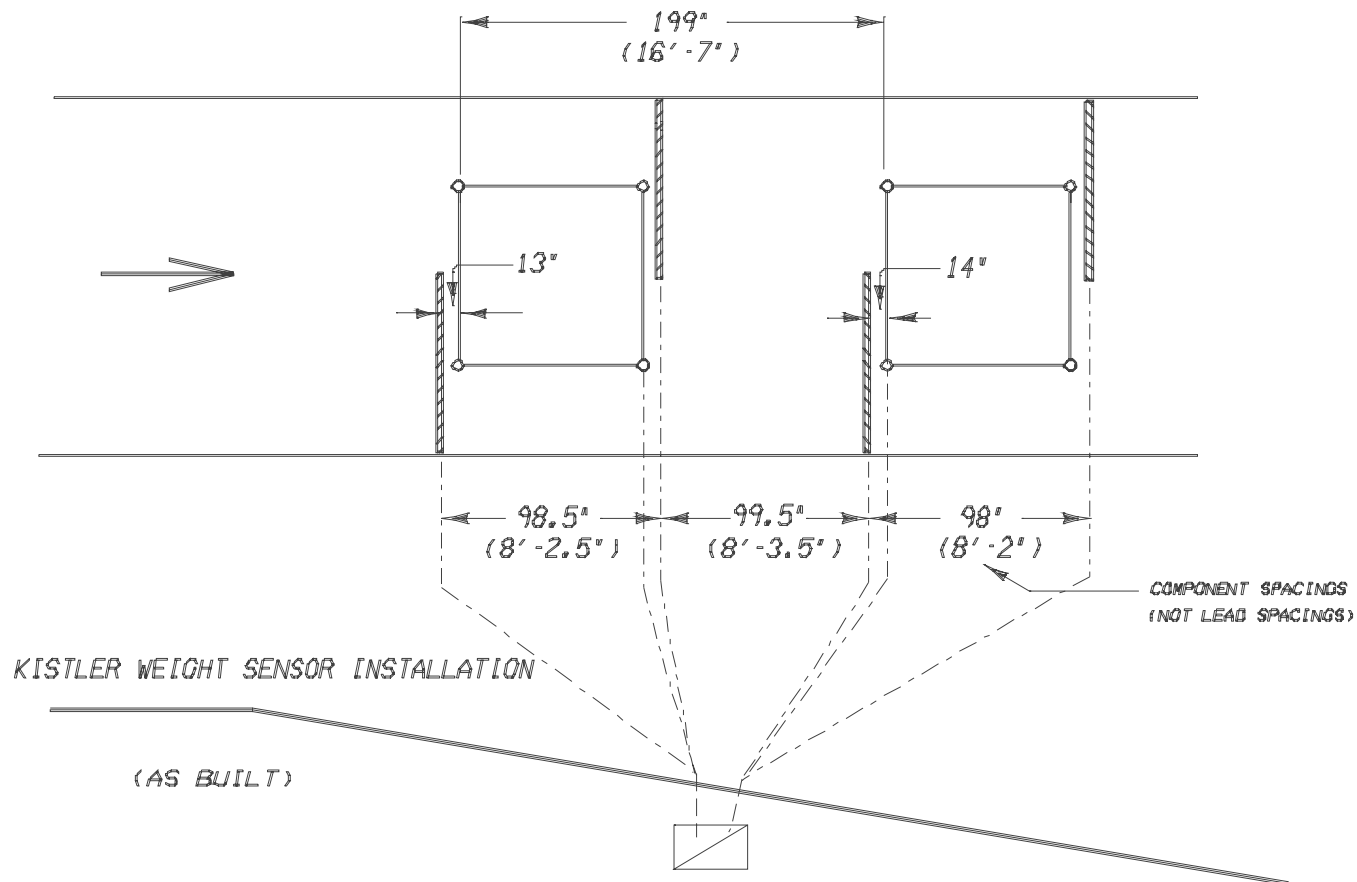
Site Description



BL Sensor Layout



Kistler Sensor Layout



Main Cabinet - Kistler



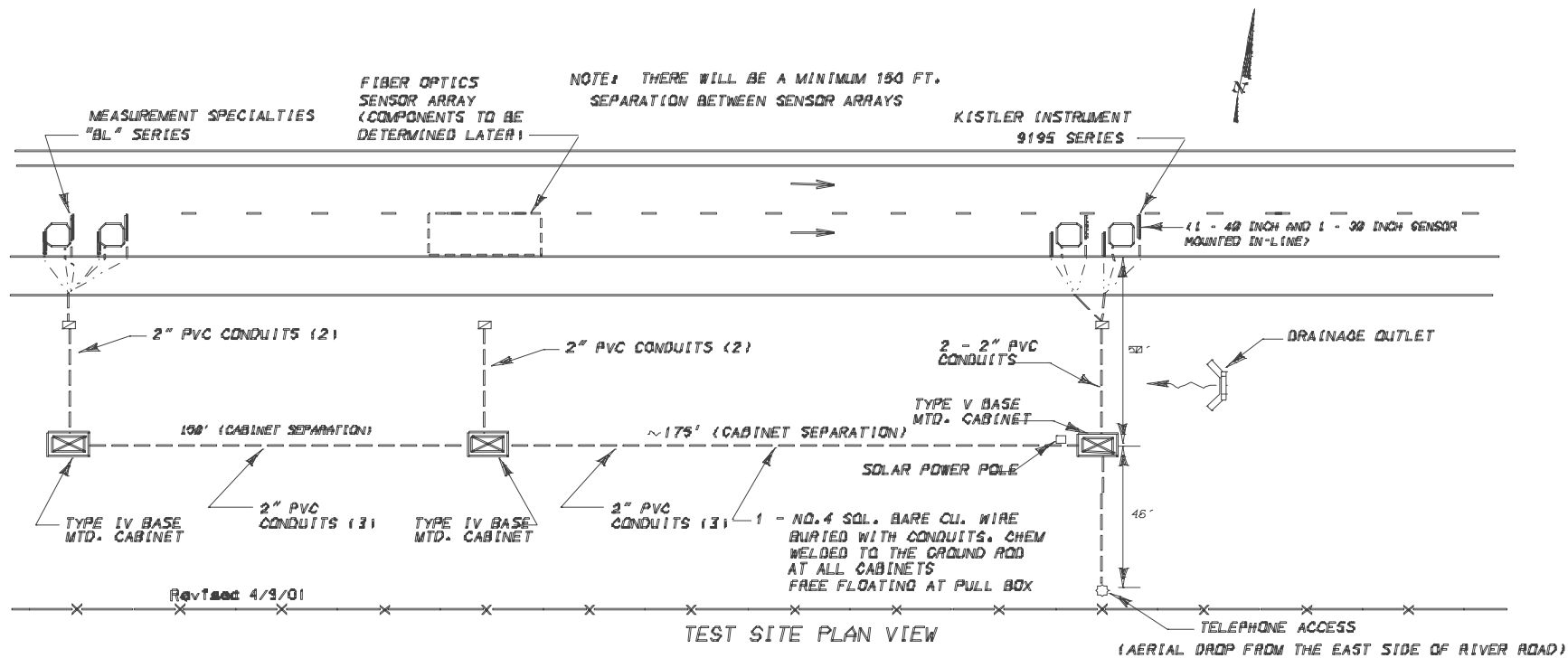
Kistler Sensor – In-Line Connection



Kistler Sensor - Installed



Survey Procedure



Survey Procedure



Target Vehicles

FHWA scheme “F” type 9 vehicles

Traditional 3-axle tractor/2-axle trailer

GVW \geq 40,000 lb.

No tankers or other trailers with shifting loads

100 vehicles per session

2 Days - 4 Survey Sessions

- 12/11/01 (am) – Peek ADR connected to Kistler sensors
- 12/11/01 (pm) – Peek ADR connected to Kistler sensors,
- 12/12/01 (am) – PAT DAW190 connected to Kistler sensors
 - Peek ADR connected to MSI “BL” sensors
- 12/12/01 (pm) - PAT DAW190 connected to Kistler sensors
 - Peek ADR connected to MSI “BL” sensors

Calibration

- Calibration factors are determined each day
- Factors were established using 30 vehicles from the traffic stream before beginning data collection

Accuracy Requirements

- Functional performance requirements for a Type II WIM system (ASTM E-1318) – 95% or more of the vehicles must meet all of the following criteria:
- Be within a 25% differential for steering axle weights
- 20% differential for drive tandem & trailer tandem weights
- 15% differential for gross vehicle weights

Tabulated Weight Records

- Detail Analysis Tables (Excel Spreadsheet)
 - Contains individual weight records from WIM and the corresponding static scale record
 - % diff. between WIM & static weight for each axle group
 - Flags entries that exceed the allowable % diff.
 - Flags invalid records such as off-scale at WIM, bypass enforcement scales, or tanker type vehicles, etc.

Detail Analysis Table (Sample)

GrWt	>=	0	And	GrWt	<	999999												
				25.00%				20.00%				20.00%		15.00%				
Num	Type	Time	AxWt1	%Err	AxWt2	AxWt3	AxWt23	%Err	AxWt4	AxWt5	AxWt45	%Err	GrWt	%Err		CalFac	Status	Sensor
1	Changing lanes						32430				31140		FALSE					
		9:42:55	11200		19100	15900	35000		19500	16600	36100		82300				FFFF	00FF
2	Static	9:44:31	11980				21660				12640		46280					
	PAT	9:44:02	10800	-9.85%	9100	9300	18400	-15.05%	5200	4500	9700	-23.26%	38900	-15.95%				
	Adr	9:44:10	11700	-2.34%	9800	10000	19800	-8.59%	6400	6700	13100	3.64%	44600	-3.63%			FFFF	00FF
3	Static	9:46:26	10480				15280				15620		41380					
	PAT	9:46:01	9600	-8.40%	6700	7500	14200	-7.07%	6200	7700	13900	-11.01%	37700	-8.89%				
	Adr	9:46:10	11700	11.64%	9800	8900	18700	22.38%	8200	8900	17100	9.48%	47500	14.79%			FFFF	00FF

Summary of Weight Errors

	Total No.	Total No.	No. Error	No. Error	No. Error	No. Error
	Matched	Error Recs	Recs	Recs	Recs	Recs
	Records		Steering Axle	Drive Tandem	Trailer Tandem	GVW
			[25%]	[20%]	[20%]	[15%]
12/11/2001 (am)						
PEEK / KISTLER	92	17	1	9	15	11
Pvmt. Surf. Temp. ~ 69 F						
12/11/2001 (pm)						
PEEK / KISTLER	98	8	1	2	7	4
Pvmt. Surf. Temp.						
69 - 73 F						
12/12/2001 (am)						
PAT / KISTLER	101	13	2	3	10	7
PEEK / BL	100	33	3	11	26	19
Temp. 67 - 74 F						
12/12/2001 (pm)						
PAT / KISTLER	99	15	3	4	10	2
PEEK / BL	99	19	1	11	10	9
Temp. 75 - 82 F						

Some Results and Generalizations

Temperature variation has not been completely addressed.

The Second phase of surveys scheduled for April were postponed due to the opening of the new truck weight enforcement scale. (Undergoing equipment acceptance)

Conduct phase II this summer when surface pavement temps will exceed 100F

Results and Generalizations

- Basically, neither the Peek/Kistler combination (190 records), the PAT/Kistler combination (200 records) or the Peek/BL combination (199 records) passed the 95% confidence level threshold.
- There was a tendency for BL sensors to gain accuracy with the slightly warmer afternoon temps
- Temp. variation did not change the no. of error records from the Kistler sensors. Note that there was not a large variation in temp. either day.

Acknowledgements

This was a cooperative effort involving:

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Digital Traffic Systems – Bill Dollar & field crew

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PAT America

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